Soc Sci Med Vol 26, No 7, pp 751–760, 1988
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0277-9536/88 $3.00 + 0.00
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LIFE-HISTORY CORRELATES OF ENVIRONMENTAL TOBACCO SMOKE: A STUDY ON NONSMOKING HONG KONG CHINESE WIVES WITH SMOKING VERSUS NONSMOKING HUSBANDS

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Abstract—Studies to evaluate the effects of environmental tobacco smoke (ETS, passive smoking) often use nonsmoking wives with smoking discordant husbands. To see whether there were differences in exposures and behavior patterns among never-smoked wives with never-smoked vs ever-smoked husbands, the life-history profiles of 136 ever-married women with mean age of 59 were analyzed on 97 quantifiable variables. Overall, the results demonstrated that wives with never-smoked husbands had 'healthier' lifestyles than wives with smoking husbands. The former were better off in terms of socio-economic status, more conscientious housewives, ate better diets, and had better indices of family cohesiveness. They also fared better in variables that reflected health status with lower frequencies of the following: miscarriages, abortions, inhaling through the mouth, chronic cough, and chest X-rays. The differences were usually largest when comparing wives of never-smoked vs heavily smoking (>20 cigarettes/day) husbands. The results indicate some correlates of passive smoking that can act as important confounders when evaluating health risks among families with smoking husbands.

Key words—passive smoking, Chinese, lung cancer, environmental tobacco smoke, heart disease

In recent years there has been increasing research on the possible detrimental health effects from exposure to environmental tobacco smoke (ETS) or passive smoking. With the results of Trichopoulous *et al.* [1] and Hirayama [2] indicating an increased risk for lung cancer among nonsmoking wives married to smoking vs nonsmoking husbands, there has been a number of studies suggesting, among others, that ETS also increases the risk for a range of cancers [3], heart disease [4], pulmonary function and growth among children [5, 6], and respiratory symptoms among exposed family members [7, 8].

Most of these studies defined exposure by asking the subject whether the spouse/parent had smoked (yes/no), their duration of smoking (in years), and the number of cigarettes smoked per day. Whether these questions really measure dosage levels among those passively exposed, or merely indicate the smoking status of the spouse/parent are still controversial issues [9]. Furthermore, it cannot be excluded that having a smoking family member is associated with other lifestyle habits which could act as confounders and increase the risk of disease formerly related to ETS [10, 11].

For example, ETS was found by Friedman's group [12] in the San Francisco area to be associated with increased alcohol intake, marijuana use, and hazardous occupations among the exposed subjects. Another study [13] found that smoking husbands had more sexual partners than nonsmoking husbands. Mantel [11] suggested that important differences could exist between *families* with a smoking husband and those without. It therefore seems appropriate to compare the life-history profiles of wives married to smokers and nonsmokers.

METHODOLOGY

Data collection

From 1981 to 1983, 200 female lung cancer cases and 200 female controls were interviewed as part of a retrospective study on lung cancer in Hong Kong [14, 15]. The control subjects were randomly selected from lists of household members who lived in the same districts and housing type (public or privately owned) as the cases. From among the 200 district controls, 136 women were identified as nonsmoking wives. Nonsmokers were defined as those who had never smoked more than 20 cigarettes in their life times, and wives were women who had ever been married. None of the subjects had remarried. The mean age of the 136 subjects was 59.3 (SD 9.9), of which 40 (29%) were widows, 3 (2%) were separated, and 3 (2%) were divorced.

Since most women married in young adulthood and lived with their husbands for a majority of their adult lives, it was considered that any effects on lifestyles and habits should still be apparent although their husbands might no longer be present. This material then comprises all ever-married women. Analysis using only currently married wives was also done but not shown here since the life-history profiles between the ever-married and currently married wives were not noticeably different.

The husband's smoking status, whether he was still cohabiting, separated, or dead at the time of interview, was defined by the usual number of cigarettes he smoked per day when he lived with his wife and was an active smoker. The 8 ex-smoker husbands were classified by the number of cigarettes they consumed when they were smoking.

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Source: https://www.industrydocuments.ucsf.edu/docs/qgyx0000

All subjects were interviewed in their homes by two females with college degrees in sociology and previous experience in survey research. They underwent extensive training in carrying out interviews for this study, which included role playing and sensitivity to nonverbal communication and probing techniques. All of their recorded results were checked to monitor for inter- and intra-interviewer and -interviewee consistency and ensure that the data were of high quality and loose ends had been properly explored. Sometimes this meant that subjects had to be recontacted. These quality control procedures were maintained because some of the questions in the interview were semi-structured.

In this type of retrospective study, it was deemed important that a proper framework with appropriate probes be developed by the interviewer to facilitate recall by the informant on exposures in the distant past. Simultaneously, the interviewee was being trained to think retrospectively. Since the life-histories of each subject would be different and their levels of education and recall varied, the probing language would have to be adjusted individually. A general framework was established early in the interview by asking about residential histories, i.e. since birth, where the subject had lived (province, city/village), what type of housing, the number of rooms, how many household members had lived together, etc. These questions were repeated for each change of residence up to the time of interview. With this time, place, and general socio-economic framework, the interviewer was able to describe a setting to help an interviewee's recall or double-check data for consistency when subjects were asked questions pertaining to marriage, birth of children, ETS exposures, fuel types used in the home, exposures to possible hazardous chemicals/occupation, diet, etc. To facilitate this active probing by the interviewer and reduce the duration of the interview, all conversations were tape recorded so that the interviewer would not have to think and record all the data simultaneously. Sparse notes were taken during the interview on key points and to establish the residential histories. Within a couple days after each interview, the data were transcribed onto cards. On an average, each interview lasted 1.5–2 hr.

Statistical analysis and operational definitions

Among the data that were collected, 97 variables were quantifiable and judged to be of possible interest in this study on life-history exposures among nonsmoking wives. The information was grouped into 7 topical sections: ETS exposures, demographic background, reproductive histories, home exposures and activities, personal habits and activities outside the home, medications and health history, and dietary habits. Mean values were calculated for each variable with the denominator being the total number of subjects in each group. Among the variables described as "__/month", "__/year", or "__/exposed", the denominator was limited to those who were exposed since this would indicate their intensity of exposure. The variable preceding these measurements would already give the percentage exposed in each group.

Chi-square tests and *t*-tests were performed when comparing the values among wives with never-smoked (NS) vs ever-smoked (ES) husbands, light smokers (LS), i.e. 1–20 cigarettes/day, vs heavy smokers (HS), i.e. 21+ cigarettes/day, never-smoked vs heavy smokers, and never-smoked vs light and heavy smokers. Only the *P*-values for the first will be presented in the tables. Statistically significant *P*-values of the others will be discussed in the text.

To see whether there were any trends among husbands who never-smoked, were light smokers or heavy smokers, regression coefficients, unadjusted and adjusted for age were done on each variable based on the number of cigarettes the husband usually smoked per day. There was usually little difference in the results of the unadjusted and adjusted trend tests; thus only the exact *P*-values for the former will be presented.

In the design of the study, it was noted that Chinese women, especially those of Cantonese origin, emphasized the consumption of various kinds of herbs and foods to balance their metabolic systems in terms of the 'hot' and 'cold' system and to replenish their stores of body energy [16]. Because the weather is usually hot in sub-tropical Hong Kong, the consumption of 'cooling' herbal teas is popular, especially in the hot summer months. The composition of these teas is slightly varied, but some dozen herbs are common to all and they have a strong bitter taste. One of the most commonly consumed types is called '24 herbs cooling tea'. Dang Gwei (*Angelica polymorpha*) and *Pak Fung Yuen* ('White Phoenix Pills') are Chinese medicines specifically for nourishing women, especially after the menses or giving birth. They are reputed to help restore the blood, regulate the menses, and act as tonics since menstruation and giving birth are seen as depleters of body energy stores. *Gei Ji* (*Fructus lycium*) is a general tonic that can be consumed by anyone. It is frequently added to pork bone or chicken soup to create a 'nourishing' tonic soup (*bo tong*) for the whole family. Vitamins were generally perceived as a Western type of tonic. These data were gathered in the study and presented here because they were culturally specific types of health promoting behavior.

When subjects were asked about their frequencies of consuming 15 different foods or food groups, the answers were originally coded into 6 mutually exclusive categories: never, less than 1/month, 1–3 times/month, 1–4 times/week, 5–7 times/week, and 2 or more times/day. These categories were converted into the average number of times these foods would be eaten per month, giving each of the above categories the following weights respectively: 0, 1, 2, 11, 26 and 61. Then these weights were assigned to each subject for each food item and the mean values were calculated accordingly.

RESULTS

There were 70 women whose husbands had never smoked (NS) cigarettes and 66 whose husbands had smoked (ES) them sometime during their married life together. Among the smoking husbands, 74% ($N = 49$) smoked 20 or fewer cigarettes per day and therefore were defined as light smokers (LS), whereas

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Table 1. Environmental tobacco smoke exposure of nonsmoking wives with nonsmoking vs smoking husbands

Exposure variable	Mean values* for wives					
		Smoking husband				
	Nonsmoking husband, $N = 70$	Light smoker, 1–20 cig/day, $N = 49$	Heavy smoker, >20 cig/day, $N = 17$	P-value†	All smokers, $N = 66$	Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
At home						
Percent exposed to tobacco	31%	100%	100%	—	100%	—
Years exposed to tobacco	13.27	31.14	31.59	0.0001§	31.26	0.71
Hundred hours exposed to tobacco	53.38	216.88	252.07	0.55	227.65	0.0001
Percent exposed from parents	7%	8%	18%	0.38	11%	0.48
Years exposed to parental tobacco	24.20	45.75	21.00	0.94	35.14	0.07
Hundred hours exposed to parental tobacco	242.60	474.75	114.33	0.93	320.29	0.83
Percent exposed from husband	6%	100%	100%	—	100%	—
Years exposed to husband's tobacco	29.25	28.86	27.82	0.71	28.59	0.71
Hundred hours exposed to husband's tobacco	127.25	185.53	225.24	0.31	195.76	0.27
Percent with ≥1 child(ren) smoked at home	17%	18%	6%	0.46	15%	0.75
At work						
Percent exposed at work	9%	8%	12%	0.90	9%	0.92
Years exposed to tobacco	8.00	10.50	15.50	0.33	12.17	0.24
Hundred hours exposed to tobacco	104.33	208.50	85.50	0.71	167.50	0.06
From home and work						
Percent exposed from home and work	44%	100%	100%	—	100%	—
Years exposed to tobacco	15.35	31.47	32.06	0.0001§	31.62	0.44
Hundred hours exposed to tobacco	106.19	241.65	262.29	0.003§	246.97	0.17
Percent exposed to cigarettes	37%	100%	100%	—	100%	—
Years exposed to cigarettes	12.46	31.14	32.00	0.0001§	31.36	0.64
Hundred hours exposed to cigarettes	98.96	237.49	253.76	0.008§	241.68	0.41
Age first exposed to tobacco	49.07	21.20	21.23	0.0001§	21.21	0.0001

*Mean value for all subjects.
†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands.
‡P-value by chi-square or t-test of exact values of wives with nonsmoking vs smoking husbands.
§P-value ≤ 0.05 for age adjusted trend.
‖From cigarettes and pipe.

26% ($N = 17$) were heavy smokers (HS) consuming more than a pack per day.

Environmental tobacco smoke exposures

To study its possible association with female lung cancer, the original study made detailed enquires into past exposures to tobacco smoke [14, 15, 17]. In this paper, 14 quantitative exposure variables were selected, using average years and hours of exposure as measurements of dose and intensity among the exposed (Table 1). We differentiated between tobacco smoke, which included that from cigars, pipes, or cigarettes, and smoke only from cigarettes. Exposure was only counted if the parent, husband, other cohabitants or coworker(s) had smoked in the same room as the subject. They were not counted during periods when the parent(s), husband or cohabitant smoked outside the home, lived elsewhere, or were deceased. All of the measurements of dose among wives with NS, LS and ES husbands were statistically significant in trend when amounts from the home plus workplace were summed.

It is noteworthy that in the home environment, some 31% of the wives with NS husbands still had some exposure to tobacco smoke. Among those exposed to ETS at home, there were significant trends of increasing years ($P = 0.0001$) with increasing cigarette consumption levels by the husband.

Wives with HS husbands were about twice as likely to have had one or more parents who smoked, and among those with smoking parents, the difference in years of exposure from them was of borderline significance ($P = 0.07$) as the wives with NS husbands averaged 24.2 years vs 35.1 years for those with ES husbands. However, it should be noted that the amounts of exposure, whether in years or hours, was two or more times higher among wives with LS husbands than among wives of HS or NS husbands.

Some 6% of the wives, i.e. 4 subjects, had husbands who had smoked pipes but not cigarettes during their married life together. Among wives with some cigarette exposure from their husbands, wives with HS husbands did not have statistically higher dosage levels based on years or hours of exposure, than wives with LS husbands.

In a society where the extended family system is still revered, and adult children are expected to take care of and live with their aging parents, questions were asked about the subject's exposure to the tobacco smoke from their children. It was unexpected that children of fathers who were NS or LS were two to three times more likely to smoke at home than those with HS fathers. We do not have data on the percentage of children who were smokers.

The amount of ETS from the workplace was very slight, with only 8–12% of all wives experiencing some exposure. This is because many of the work environments (e.g. textiles, sewing, electronics) did not allow it. Among those exposed at the workplace, there was a slight tendency for wives with NS vs ES husbands to have lower exposures in terms of years ($P = 0.24$) and hours ($P = 0.06$).

When the amounts of exposure from the home and workplace were combined, some 44% of the wives with NS husbands had had previous exposure to

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Source: https://www.industrydocuments.ucsf.edu/docs/qgyx0000

Table 2. Demographic profiles of nonsmoking wives with nonsmoking vs smoking husbands

Variable	Mean values* for wives					
	Nonsmoking husband, N = 70	Smoking husband				Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
		Light smoker, 1–20 cig/day, N = 49	Heavy smoker, > 20 cig/day, N = 17	P-value†	All smokers, N = 66	
Age	60.36	58.49	57.00	0.60	58.11	0.01
Percent family owning a car	17%	12%	12%	0.71	12%	0.41
Percent family owning a home	37%	33%	29%	0.79	32%	0.51
Years attend school	3.10	2.29	4.47	0.99	2.85	0.71
Years urban life	38.16	40.04	44.41	0.21	41.17	0.06
Years rural life	22.24	18.10	12.59	0.07	16.68	0.01
Age at marriage	21.33	22.06	24.00	0.04	22.56	0.30
Years in Hong Kong	37.83	36.53	31.76	0.09	35.30	0.69
Percent ever worked outside the home	90%	82%	70%	0.11	79%	0.07

*Mean value for all subjects.
†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands.
‡P-value by t-test of exact values of wives with nonsmoking vs smoking husbands.

tobacco, and 37% to cigarette smoke. From these data among the exposed, it was estimated that about 81–99% of the total years and 93–98% of the total hours of tobacco exposure from the home and work environments came from cigarettes. Among wives with LS husbands, 92% of their total tobacco exposure came from their husbands, and this proportion was 87% among wives with HS husbands.

As would be expected, there were highly significant increasing trends of years or hours of exposure from tobacco or cigarette smoke, among wives with NS, LS and HS husbands.

Wives with ES husbands were first exposed to tobacco at around 21 years of age vs 49 years of age for those with NS husbands, and this difference was significant.

Demographic profiles

Table 2 shows the values for selected demographic variables. Wives with NS husbands averaged 2 years older ($P = 0.01$) than those with ES husbands. Three variables gave some indication of socio-economic status: percent of families owning a car, percent of families owning their own home, and the number of years each subject had attended school. For all three indicators, families with a NS husband tended to be slightly wealthier and their wives better educated than ES families. The percentages of families that owned both a car and a home were 13% for wives with NS husbands vs 5% with ES husbands, and this difference was of weak statistical significance (P-value = 0.09).

Wives with ES husbands usually spent most of their lives in urban areas (usually Hong Kong, Guangzhou, Shanghai, Beijing), married later, and were more likely to have spent their adulthood as housewives. In contrast, wives with NS husbands usually spent much of their childhood, early adulthood, and were married in rural areas (mostly in Guangdong Province), and were more likely to have had experience in working outside the home. These differences were most apparent in the years spent in rural life, age at marriage, and percent ever working outside the home, with P-values for the trends among those with NS, LS and HS husbands ranging from 0.04 to 0.11.

Reproductive and gynecological histories

There were some interesting differences in the reproductive histories of the wives (Table 3). The most outstanding one was that wives with ES husbands were more likely to have miscarriages or abortions, resulting in more instances of surgical dilatation and curettage (D & C). Wives with NS husbands were 1.5–2 times less likely to have a miscarriage/abortion or D & C than wives with ES

Table 3. Reproductive and gynecological histories of nonsmoking wives with nonsmoking vs smoking husbands

Variable	Mean values* for wives					
	Nonsmoking husband, N = 70	Smoking husband				Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
		Light smoker, 1–20 cig/day, N = 49	Heavy smoker, > 20 cig/day, N = 17	P-value†	All smokers, N = 66	
Number of pregnancies	4.90	5.73	5.29	0.66	5.62	0.05
Number of live births	4.40	5.12	4.06	0.87	4.85	0.09
Percent had ≥ 1 miscarriages/abortions	33%	43%	59%	0.12	47%	0.09
Percent had ≥ 1 dilatation and curettage	16%	35%	23%	0.06	32%	0.03
Age at menarche	15.96	15.63	16.00	0.99	15.73	0.41
Age at menopause	47.72	47.90	47.53	0.26	47.80	0.19
Percent with regular menstruation	84%	76%	76%	0.46	76%	0.21

*Mean value for all subjects.
†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands.
‡P-value by chi-square or t-test of exact values of wives with nonsmoking vs smoking husbands.

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Table 4 Home exposures and activities of nonsmoking wives with nonsmoking vs smoking husbands

Variable	Mean values* for wives: Nonsmoking husband, N = 70	Smoking husband: Light smoker, 1–20 cig/day, N = 49	Heavy smoker, > 20 cig/day, N = 17	P-value†	All smokers, N = 66	Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
Cooking and heating fuels						
Years wood + grass	31.96	34.73	25.88	0.80	32.45	0.47
Years kerosene	19.34	19.84	19.76	0.89	19.82	0.90
Years liquid petroleum gas	7.06	6.90	5.47	0.50	6.53	0.97
Years charcoal	5.01	0.90	3.12	0.08	1.47	0.0001
Years cooking	36.13	36.16	30.06	0.41	34.59	0.03
Years washing clothes by hand	38.00	36.35	36.41	0.94	36.36	0.01
Years house cleaning	35.11	35.08	31.41	0.78	34.14	0.02
Years house painting extensive repairs	2.97	1.33	1.71	0.92	1.42	0.0001
Percent burnt incense	73%	84%	76%	0.38	82%	0.21
Years burner of incense	38.06	35.49	29.61	0.18	34.07	0.43
Percent burnt religious candle	61%	71%	70%	0.48	71%	0.23
Years burner religious candle	38.37	34.80	27.00	0.05	32.81	0.27
Percent used mothballs	94%	100%	100%	0.80	100%	—
Percent used insecticidal sprays	69%	78%	65%	0.46	74%	0.47
Percent burnt mosquito coil	26%	27%	35%	0.72	29%	0.69
Years burner of mosquito coil	10.28	7.77	3.33	0.18	6.37	0.01

*Mean value for all subjects

†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands

‡P-value by chi-square or t-test of exact values of wives with nonsmoking vs smoking husband

husbands, and there was a significantly increasing trend ($P = 0.06$) with increasing number of cigarettes smoked by the husband for D&C. Most of the abortions were actually miscarriages, as the common Chinese term includes both concepts. In this age group, only a few reported induced abortions as a method of birth control. In traditional ideology, greater numbers of children meant greater fortune. Women with ES husbands also tended to have more pregnancies.

Among the three variables reflecting the woman's menstrual patterns, i.e. the age it began, the age it stopped, and its regularity, no differences were apparent among the wives.

Activities and exposures in the home

The results from the comparative histories of these exposures (Table 4) have to take into account that wives with NS husbands tended to be 2–3 years older than those with ES husbands. Thus one would expect the former group to have longer durations of exposure for many of these variables.

To assess sources of indoor air pollution, subjects were asked about their duration of usage of various types of fuels for cooking and heating. Wives with NS husbands were significantly exposed to more years of charcoal than those with ES husbands.

Among other activities typical of Chinese housewives, the mean values were significantly higher among wives with NS vs ES husbands in their durations of cooking, washing clothes by hand, housecleaning and house painting/repairs. Most of these differences can probably be attributed to the older age of the wives of NS husbands. However, wives with HS husbands spent on average 30.1 years in cooking vs 36.1 years among wives with NS husbands, and this difference (6.1 years) is greater than their differences in age (3.4 years).

Table 5 Personal habits and activities outside the home of nonsmoking wives with nonsmoking vs smoking husbands

Variable	Mean values* for wives: Nonsmoking husband, N = 70	Smoking husband: Light smoker, 1–20 cig/day, N = 49	Heavy smoker, > 20 cig/day, N = 17	P-value†	All smokers, N = 66	Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
Percent regularly inhaled through mouth	3%	10%	12%	0.19	11%	0.07
Percent snored when sleeping	14%	20%	12%	0.58	18%	0.54
Percent regularly worshipped at temple	36%	55%	41%	0.11	52%	0.06
Years worshipper at temple	30.44	31.78	22.86	0.17	29.94	0.54
Times year worshipped at temple	3.16	2.26	2.00	0.11	2.21	0.17
Percent regularly played majong	27%	28%	41%	0.52	32%	0.55
Years player of majong	8.53	8.64	9.57	0.67	8.95	0.90
Times month played majong	9.63	10.92	14.71	0.30	12.25	0.64
Percent regularly ate *dim sum* lunch breakfast	61%	57%	29%	0.06	50%	0.18
Percent regular physical exercise	39%	31%	35%	0.67	32%	0.41

*Mean value for all subjects

†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands

‡P-value by chi-square or t-test of exact values of wives with nonsmoking vs smoking husbands

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Source: https://www.industrydocuments.ucsf.edu/docs/qgyx0000

Other sources of possibly hazardous fumes, smoke, and chemicals in the home typical of this cultural-geographical area were investigated. The percentages of those engaged in these activities: burning of incense (73–84%) and candles (61–71%) for ancestor and religious worship, and the use of mothballs (94–100% used some) and insecticidal sprays (65–78%), showed that these exposures were almost ubiquitous among all groups.

Although there were no significant differences in the percentages of those who burned (yes/no) incense or candles for religious or ancestor worship, the duration in years of such burning was always shortest among wives with HS husbands, and this trend was significant for religious candles ($P = 0.05$).

From 26 to 35% of the wives reported previous use of mosquito coils, which were usually burned 3–4 months per year during the summer months. Among the exposed, the 18 wives with NS husbands were significantly exposed to more years of mosquito coil (10.3) than the 19 wives with ES husbands (6.4).

Personal habits and activities outside the home

Various personal habits and activities outside the home were studied (Table 5). As an indication of respiratory habits, subjects were asked whether they had, for any periods of time greater than a few months and not due to a current cold/flu infection, inhaled primarily through their mouth and whether they snored during sleep. Three percent of the wives with NS husbands vs 11% with ES husbands were mouth inhalers ($P = 0.07$), indicating possible obstruction of their nasal passages. No significant differences were observed in rates of snoring although this habit has been associated with hypertension and heart disease [18, 19].

Although wives with ES husbands were more likely to visit temples or churches than wives of NS husbands ($P = 0.06$), wives with HS husbands consistently were the least frequent observers of religious activities by having the lowest figures for years and number of times/year they visited religious temples. On the other hand, they were the most likely to be regular gamblers by playing majong for more years and times per month than any of the other wives.

Dim sum is a Cantonese type of meal usually consumed at breakfast or lunch, where small portions of savory and sweet dumplings, meats, seafoods, etc. are served and consumed with large amounts of tea. Elderly women would usually go with family members to eat this, so it was an indirect sign of family cohesiveness. Wives with HS husbands were about half as likely to regularly eat *dim sum* as wives with LS or NS husbands, and the percentages increased as the husband smoked fewer cigarettes (chi-square P-value = 0.06).

Medications and health history

A comparison of their habits in taking Chinese herbal tonics/teas and patent medicines, and their history of respiratory symptoms is shown in Table 6. For most of the herbal tonics and 'cooling' teas, wives of HS husbands had among the higher percentages of being consumers. However, their duration in years, and frequency in times/year of consumption of the tonics and 'cooling' teas were always the lowest figures among the three groups of wives, with the exception of *Dang Gwei*. This exception may have arisen from their perceived need to supplement their bodies as a result of their higher frequency of unsuccessful pregnancies since the use of food tonics for this purpose is usually prescribed in this society [16].

Yet, on the other hand, the duration and frequency of consumption of these herbal tonics, teas and vitamins were, with the exception of years/drinker of 'cooling' teas, always the highest for wives with LS husbands. Thus, in the comparison of wives with NS vs ES husbands (where wives with HS husbands formed only 26% of those with ES husbands) the

Table 6 Histories of medication and past health of nonsmoking wives with nonsmoking vs smoking husbands

Variable	Mean values* for wives					
	Smoking husband					
	Nonsmoking husband, $N = 70$	Light smoker, 1–20 cig/day, $N = 49$	Heavy smoker, > 20 cig/day, $N = 17$	P-value†	All smokers, $N = 66$	Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
Percent took *Pak Fung Yum*	11%	10%	18%	0.71	12%	0.90
Percent took *Dang Gwei*	43%	39%	65%	0.17	45%	0.76
Years/taker of *Dang Gwei*	9.83	15.05	14.00	0.31	14.67	0.16
Times/year took *Dang Gwei*	14.35	23.79	14.82	0.85	20.50	0.05
Percent took *Gei Ji*	70%	67%	76%	0.78	70%	0.97
Years/taker *Gei Ji*	15.37	18.33	10.38	0.35	16.09	0.99
Times/year took *Gei Ji*	17.36	21.66	12.85	0.93	19.27	0.02
Percent took vitamins	9%	14%	12%	0.62	14%	0.35
Percent drank 'cooling' herbal teas	40%	55%	41%	0.25	52%	0.18
Years/drinker 'cooling' teas	21.11	19.41	16.43	0.81	18.79	0.86
Times/year drank 'cooling' teas	18.25	22.00	12.50	0.64	19.89	0.004
Percent frequently took patent medicine for colds, cough, headache, pain	11%	8%	18%	0.55	11%	0.88
Percent with previous chest radiographs	48%	49%	59%	0.74	52%	0.73
Number of chest radiographs/person	3.85	5.71	7.00	0.31	6.09	0.01
Percent with chronic sputum	9%	8%	18%	0.48	11%	0.69
Percent with chronic cough	14%	4%	29%	0.02	11%	0.52

*Mean value for all subjects

†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands.

‡P-value by chi-square or t-test of exact values of wives with nonsmoking vs smoking husbands.

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Table 7. Dietary habits of nonsmoking wives with nonsmoking vs smoking husbands

Variable	Mean values* for wives					
		Smoking husband				
	Nonsmoking husband, N = 70	Light smoker, 1–20 cig/day, N = 49	Heavy smoker, >20 cig/day, N = 17	P-value†	All smokers, N = 66	Nonsmoking vs smoking husband, t-test or chi-square test P-value‡
Frequency of consumption per month						
Cruciferous vegetables	2.91	1.88	2.35	0.71	2.00	0.001
Fresh leafy green vegetables	43.66	45.90	40.70	0.84	44.56	0.87
Carrots	3.29	2.82	1.53	0.31	2.48	0.0003
Beans, legumes	2.97	1.86	2.00	0.25	1.89	0.0001
Bean curd and soy products	5.07	4.78	4.59	0.63	4.73	0.42
Fresh fruit	25.94	26.31	25.29	0.80	26.05	0.19
Fresh fish, seafood	32.56	34.47	36.88	0.34	35.09	0.87
Dried salted fish, seafood	4.73	6.26	8.41	0.24	6.82	0.09
Cured smoked meat, sausage, poultry	3.81	4.20	5.18	0.45	4.45	0.25
Pickled salted vegetables	7.01	9.94	7.76	0.78	9.38	0.0001
Chili, fresh or sauces	1.94	4.61	5.65	0.17	4.88	0.0001
Fermented and salted bean products§	5.21	4.49	6.24	0.85	4.94	0.02
Milk totaling 1 cup	7.21	2.88	2.71	0.07	2.83	0.0001
Home cooked soup (*Bo-tong*)	9.46	7.59	13.23	0.07	9.04	0.05
Mean values for wives						
Percent used corn oil in cooking	31%	18%	24%	0.27	20%	0.12
Percent drank alcohol regularly	19%	27%	12%	0.36	23%	0.55
Years drinker of alcohol	3.23	8.63	3.53	0.34	7.29	0.0001

*Mean value for all subjects.

†P-value for trend by linear test on regression coefficient by number of cigarettes/day smoked by the husband, or chi-square test of wives with nonsmoking, light and heavy smoking husbands.

‡P-value by chi-square or t-test of exact values of wives with nonsmoking vs smoking husbands.

§e.g. bean sauce, bean paste, "black" beans.

latter were significantly more frequent consumers per year of *Dang Gwei*, *Gei Ji*, and 'cooling' teas.

When asked whether they never, seldom, or frequently consumed over-the-counter patent medicines for such common symptoms as cold, cough, headache, and pain, 18% of the wives of HS husbands, vs 11% of those with NS and 8% of those with LS husbands answered that they consumed these medicines frequently, although these differences were not statistically significant.

With the high prevalence of tuberculosis in Hong Kong, about half of the women remembered having had at least one chest radiograph in the past. Among those who had had previous chest radiographs, wives of ES husbands had significantly more of them than those with NS husbands, and the average number of chest radiographs increased with the amount of smoking by the husband, although this trend was not significant. With poor doctor–patient communication and large numbers of subclinical/untreated tuberculosis in Hong Kong, most women could not recall whether they had been diagnosed with tuberculosis, so that answers to this question did not produce useful results.

Questions on sputum and cough were asked to give an indication of bronchial irritation. To avoid symptoms that might have been the result of cold/flu, sputum production and coughing were counted positive only if their durations had been greater than 6 months. Women with HS husbands were twice or more likely to suffer from these respiratory symptoms than women with LS or NS husbands, and the percentages of those with chronic cough significantly increased with the cigarette consumption levels of the husband ($P = 0.02$).

In general, wives with ES husbands were statistically more frequent consumers per year of traditional herbs like *Dang Gwei*, *Gei Ji*, and 'cooling' teas than wives of NS husbands. Among all 3 herbal concoctions, the wives of LS husbands were always the most frequent consumers, and wives of HS husbands the least frequent consumers.

Dietary habits

Wives with NS husbands tended to consume cruciferous vegetables, carrots, beans/legumes, fermented and salted bean products, and bean curd more frequently per month than those with ES husbands (Table 7). These differences were statistically significant for the first four items. On the other hand, they reported eating fresh fish, dried and/or salted fish, and cured/smoked meats (e.g. sausage, ham, pressed salted duck) less often, in a dose–response fashion with increased smoking by the husband. In addition, spicier foods such as pickled/salted vegetables and chilis and chili sauces were statistically more commonly consumed by the wives with ES than the NS husbands.

Since adults in this population rarely drank milk by itself but added it to tea, coffee, malted milk or cocoa, they were asked about their frequency of drinking a cumulative total of 1 cup of milk. Wives with ES husbands were found to be significantly less frequent consumers of milk, and this trend increased with the number of cigarettes smoked by their husbands ($P = 0.07$).

Two variables gave an indication of the household's emphasis and attitude toward home cooking. The preparation of *bo tong*, a soup that required boiling for several hours, is time and energy consuming, but highly regarded by the Cantonese as a means of furnishing additional nourishment in the traditional sense of health. The use of corn oil in cooking (yes/no) was asked because it was recently

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introduced with publicity that using corn oil, rather than lard, peanut, or rapeseed oil, is healthier. Those who used corn oil would show that they were aware of its benefits and acted upon it, although peanut oil produced more fragrant cooking and rapeseed oil is cheaper. For both of these indicators of concern for 'healthy' cooking, households with NS husbands fared better.

In the original interviews, a number of questions were asked about consumption of specific types of alcoholic drinks: Chinese wine, Chinese tonic wines, Chinese liquor, Western wines and Western brandy liquor. Drinkers were defined as those who consumed these drinks one or more times a week. Most subjects said that they were intolerant to alcohol or felt uncomfortable after drinking it. Some only drank during infrequent social occasions such as weddings or holidays where toasting was a matter of courtesy. The actual percentage of drinkers (12–27%) was low, and those who did so usually said that they drank various Chinese tonic wines for health reasons such as nourishing their blood. These tonic wines are tinctures produced by soaking tonic herbs such as ginseng or animal products such as deer antler, tiger bones, snakes, etc. in wine. In comparing wives of NS vs ES husbands, the former were less likely to be drinkers 19% vs 23% ($P = 0.55$) and those who drank did so for shorter durations, averaging 3.2 vs 7.3 years ($P = 0.0001$).

DISCUSSION

The results from this study showed that wives had different behavior patterns and exposures to possibly noxious substances in the environment, when they were classified according to their husbands' smoking habits. As would be expected, most of the measurements on dose of ETS from the home plus workplace were significant in trend when wives with NS, LS and HS husbands were compared. However, simple generalizations about exposure levels to passive smoking cannot be made based solely on the husband's cigarette consumption habits, when detailed analyses were done. Among the more important findings: (1) some 44% of the wives with NS husbands had been exposed to ETS at home or work, and among those with some exposure, their duration in years or hours were not significantly different at the $P \leq 0.05$ level than the duration among wives with ES husbands, and (2) the total exposure levels in terms of hours or years were not very different between wives with LS vs HS husbands.

In addition, it was found that wives whose parents had smoked were much more likely to marry a HS spouse, and the age at first exposure to ETS at home or work was greatly influenced by the spouse's smoking status. Wives with smoking husbands were first exposed at the mean age of 21, which is approximately the age of marriage, whereas wives with NS husbands were more than twice as old at first exposure, with a mean age of 49. The latter group's exposure usually occurred at the time when their adult sons began smoking at home. These data indicate that surveys, which are attempting to measure current levels of ETS in the environments of older women, should be careful in extrapolating the results because higher levels of current exposure in some subjects may not be indicative that this was true of their past.

Significant differences were found in the demographic backgrounds of the wives. Most noticeably, wives with ES husbands spent more of their formative years in cities, and their duration of urban residence increased with the higher cigarette consumption levels of their husbands. This might be expected, as it is generally known that city dwellers tend to smoke more than their rural counterparts, and women who lived in the cities during their young adulthood would be more likely to marry a smoking husband than rural women. However, whether early habits acquired in a rural setting, or spending one's childhood, adolescence, and young adulthood in a rural rather than urban environment, offer some protection to some of the diseases attributed to ETS, is still an open question.

Wives of HS husbands were about twice as likely to experience miscarriages than wives with NS husbands, and there was an increasing trend ($P = 0.06$) of higher percentages of wives experiencing surgical dilatation and curettage with the increased cigarette smoking habits of their husbands. In a society which values the birth of children, the finding that wives with ES husbands had on average, significantly more pregnancies (5.6) than women with NS husbands (4.9) may have indicated a compensatory behavior for the former group's larger numbers of unsuccessful pregnancies. Other aspects of the women's gynecological histories, i.e. the ages of menarche and menopause, and menstrual regularity showed no differences among the wives. This may suggest that the source of the miscarriages was from the husband, since smoking men have been suggested to have more sperm abnormalities than men who do not smoke [20].

In comparisons of exposure to cooking and heating fuels, wives with NS vs ES husbands were more likely to be exposed to charcoal ($P = 0.0001$), a fuel commonly used in rural areas in the past.

In terms of Chinese homemaking activities, wives with HS husbands spent the fewest years in cooking, housecleaning, burning religious incense or candles, burning mosquito coil, and using insecticidal sprays. These differences were most apparent in the years spent cooking and burning religious incense or candles, with wives of NS or LS husbands engaging in these activities for an average of 6–9 years longer than wives of HS husbands. One could perhaps generalize that wives with HS husbands were likely to be the least conscientious housewives.

This pattern was also exhibited in the results of their activities outside the home, with wives of HS husbands worshipping at Buddhist/Taoist/Christian temples/churches for the shortest number of years and the least frequent number of times per year, and the family going out to eat *dim sum* together the least frequently, but these wives had the highest percentages of regularly playing the gambling game, majong.

In terms of health behavior and activities directed towards the promotion of health, Chinese culture emphasizes the consumption of various herbal teas and tonics to adapt the body to seasonal changes and

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to increase one's store of energy. Although wives with HS husbands had among the higher percentages of being consumers of these products, their frequency in terms of number of times per year and duration in years of consumption were always the lowest of the three groups of wives for general tonics such as *Gei Ji*, and the 'cooling' herbal teas. They did, however, have the highest percentage of women who consumed patent medicines for such everyday symptoms as colds, cough, headache, and pain. Furthermore, wives with ES husbands had higher frequencies for taking the gynecological tonics than those with NS husbands. This may have been related to their higher rates of miscarriages/abortions as this herb is used in treating and preventing such disorders.

As a general group, the wives of women with LS husbands seemed to be the most avid consumers of these herbal tonics, 'cooling' teas, and vitamins as they usually had among the highest frequencies and durations of consumption.

The interpretation of the wives' habits in taking these medications, and indeed, any of the traditional Chinese tonics and herbs, may be difficult since it may indicate that they are more, or perceive themselves to be more sick, or that they are more likely to engage in health seeking behaviors. That the former may be true for wives with HS husbands is indicated by their highest frequencies of having chest radiographs, chronic sputum production, and chronic coughing.

In terms of diet, wives with NS husbands ate a healthier diet. Their frequencies of consuming cruciferous vegetables, carrots, beans/legumes, and milk were significantly higher than that for wives of smokers. On the other hand, the latter were more frequent consumers of cured/smoked meat products, fish (fresh and preserved), pickled vegetables, and chilis chili sauces, which would imply a diet higher in cholesterol, sodium, and *N*-nitroso compounds. These dietary patterns seem reasonable, since it is known that smokers tend to have duller taste buds than nonsmokers, and thus desire more stimulating and spicier foods. In order to meet these preferences by their husbands, wives of smoking husbands would tend to prepare meals with these ingredients, and for the sake of convenience, eat the same foods as they serve their husbands.

According to the U.S. National Research Council's 1982 report on *Diet, Nutrition and Cancer* [21], fresh leafy green vegetables, carrots, fresh fruit and milk, were identified as being protective of cancer and dried salted fish, cured/smoked meats, fermented and salted vegetables, alcohol, etc. were associated with higher risk for cancer. Wives with HS husbands always consumed the least of the former and the most of the latter. Similarly, a vegetarian diet has been linked with reduced incidence of a whole range of diseases in another study [22].

CONCLUSION

Overall, it seemed that wives with NS husbands had 'healthier' lifestyles than wives of ES husbands. The former were slightly better off financially, had more years of education, were more conscientious housewives, ate better diets, and had better indices of family cohesiveness (*dim sum*, ancestor worship by burning incense at home, visiting temples).

By contrast, wives with ES husbands were more likely to have less healthy behaviors by engaging in gambling and drinking alcohol, having poorer diets (cured/smoked meats, salted/dried fish, pickled vegetables, spicier foods), and were less conscientious housewives in terms of running the household and placing emphasis on cooking healthy foods.

In variables that reflected health status, wives with ES husbands were more likely to have a history of miscarriages/abortions, inhaling through the mouth, and chest radiographs. Wives of HS husbands had higher rates of chronic respiratory symptoms like chronic coughing and sputum production, and had the highest rates of frequently taking patent medicines for various everyday ailments.

These differences in life-history correlates were usually greatest in the comparison of families with NS vs HS husbands and may help to explain why some population studies have shown that families with a smoking husband were at higher risk of having a range of respiratory and cardiovascular health problems, cancer, poorer growth rates [23], etc.

The results from this analysis show that caution should be exercised when interpreting data on ETS. It may not be the hazards of tobacco smoke that are being evaluated, but a whole range of behaviors that result from having a smoking husband, which may in turn increase the risk for certain diseases among their wives and children. This can be from direct contact, as it is known that smokers are more likely to have upper respiratory tract infections, which increases the likelihood that other family members would be similarly affected by cross infection [7]. It can also be indirect, as the husband's preference for certain activities, e.g. gambling, drinking alcohol, and foods may encourage his wife to act and eat similarly, or be due to "assortative mating" [9].

This study is relatively small, with a total sample size of only 136 never-smoked ever-married women who had originally been selected as 'healthy' controls in a case-control study of lung cancer. In spite of this, some patterns pointing to differences in life exposures and habits based on the smoking status of the husband were found. These results indicate that more studies are needed from other communities to see whether generalizations about the past exposures and behaviors of wives with NS vs ES husbands can be made, and their consequent effects on the health of their family members.

Acknowledgements—We thank the Hong Kong Anti-Cancer Society and the U.S. National Cancer Institute's Fogarty International Center for financial assistance. Special thanks are also given to Dr J. F. Fraumeni Jr, Dr W. J. Blot, Dr J. H. Lubin and Dr B. J. Stone for help and advice in data analysis, Ms Ching-yee Ho and Katherine Lee for statistical and computer work, and Mrs Lam, Ms Chow and Ms Chu for secretarial assistance.

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